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Assessment of Groundwater and Surface-Water Resources of Gushkara in Purba Bardhaman (West Bengal, India) using the Water Quality Index

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Abstract: Survival of life on earth indispensably depends on water. Population explosion and its consequences resulted in the usable water sources being unusable in many regions. Regular monitoring of water quality becomes necessary to protect public health. The present study aimed to evaluate the water quality status of various water resources of Gushkara (West Bengal, India). The result showed that the status of the water quality index (WQI) of the studied surface-water sources is 'poor' or 'very poor' (ranges 50.582 - 87.969) whereas the groundwater and municipal water supply are rather safer (ranges 15.804 - 36.210). There is also an indication of faecal coliform contamination in surface-water sites. Overall water quality is better in winter than other two seasons. Some parameters in surface-water crossed the recommended level while some reached near that level. So immediate attention is necessary to rectify the situation.

Keywords: Water Quality Index, Ground and surface-water, Seasonal variation, Gushkara, Coliform

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Introduction

The amazing diversity of plants and animals on the globe is directly influenced by the sources of water. Today humans literally reached all the corners of the globe and explored all the possible places for establishing new habitats and activities. In the process, they explored and exploited almost all the resources of water. Most sources of freshwater are polluted to various degrees today and become unsuitable for their desired uses.

Globally, billions of people suffer and lose their lives every year from water-borne diseases (WHO, 2022). Standard drinking and usable groundwater and surface-water resources becoming scanty due to their indiscriminate unscientific use and

Fig. 1: Location map of the study area.

inadequate community awareness. Providing standard quality water to the people become a primary issue in many parts of the world. Contaminated water may also act as a breeding site for vectors (Paramanik *et al*., 2012).

The Gushkara (23.50°N - 87.75°E) municipal area of Purba Bardhaman in West Bengal, India is densely populated and stretched over more than 21 sq. km. The aim of the present study was to assess the suitability of the ground and surface-water resources using the water quality index (WQI).

Materials and Methods

Water samples were collected from 8 sampling sites (SS-1 to 8) in Gushkara municipal area (Fig. 1) including five ponds, one tube well, one well, and one municipal supply during 2018-19. All the sources are used by people for various daily purposes. APHA (2012) protocols were followed to evaluate the water quality parameters. WQI was calculated following the 'weighted arithmetic method' (Tyagi *et al*., 2013; Addisie, 2022; Kushwaha *et al.,* 2022).

Results and Discussion

Results of the sample study in summer, rainy, and winter seasons are presented in Table 1. The water of all the study sites maintains an alkaline nature with little fluctuations in different seasons, but the pH range is within the standard/recommended limit except at SS-3 (8.77) it exceeds the standard during the winter.

Dissolved oxygen (DO) in the water of all the sites is above standard (5 mg/l) in all the seasons but in many cases lower than the ideal value of 14.6 mg/l. DO at SS-2 is on the lower side (6.67-10.57 mg/l) in all the seasons probably due to contamination with nearby vehicle wash wastes. Higher DO in winter is attributed to the low temperature, less photosynthesis due to short photoperiod, and low decomposition rate.

The estimated free carbon-di-oxide (CO_2) in all the surface-water sources is near or above the standard level probably due to the presence of organic matter, decomposition, respiration, etc. whereas it is far low in groundwater samples of the area. CO_2 content is low in winter than in the other two seasons.

Total hardness (TH) in all the samples is lower than the recommended level, except at SS-6 it exceeds the safe level sometimes, which indicates the presence of calcium and magnesium salts.

Total dissolved solids (TDS) at all the sites are below the permissible limit, except at SS-2, it crosses the limit slightly during summer and

Table 1: Water quality parameters and WQI of ground and surface-water

Season	Sites	pH	DO	CO_2	TH	TDS	NO_3	SO_4	TC	FC	WQI
Summer	SS-1	7.83	13.23	6.87	170.14	413.33	38.25	209.91	14	6	72.624
	SS-2	7.84	7.32	5.11	158.02	523.64	22.24	170.31	12	0	80.160
	SS-3	8.28	11.26	7.13	210.00	394.47	37.55	196.76	28	4	87.704
	SS-4	7.56	11.17	6.47	191.13	401.85	30.21	191.33	14	2	72.267
	SS-5	7.71	12.05	6.97	173.33	440.24	19.67	168.67	16	3	73.651
	SS-6	8.25	14.66	1.14	314.21	254.97	4.12	40.44	0	0	27.253
	SS-7	7.82	14.13	1.51	255.09	374.21	5.71	74.68	0	0	26.086
	SS-8	7.43	15.33	2.85	131.97	238.58	8.87	56.66	0	0	25.579
Rainy	SS-1	7.64	12.54	6.61	148.00	342.28	48.77	194.23	23	4	71.324
	SS-2	7.41	6.67	4.18	123.67	488.68	26.67	180.22	10	0	70.078
	SS-3	8.11	11.06	7.03	149.00	358.12	32.94	206.67	31	5	84.792
	SS-4	7.44	11.61	6.75	146.00	369.97	32.32	210.84	35	8	71.089
	SS-5	7.55	11.87	6.79	151.06	412.67	31.11	198.26	27	0	71.839
	SS-6	8.02	14.32	1.55	288.14	269.61	3.37	45.94	0	0	28.158
	SS-7	7.58	13.51	1.34	214.20	288.88	4.55	58.68	0	0	23.455
	SS-8	7.45	15.11	4.16	157.00	190.11	7.06	86.68	4	0	36.210
Winter	SS-1	7.94	14.44	5.83	160.88	395.98	44.44	166.63	10	3	62.168
	SS-2	8.02	10.57	3.82	144.10	505.33	47.11	188.84	7	0	63.076
	SS-3	8.77	13.75	7.47	180.00	345.45	40.33	215.11	16	0	87.969
	SS-4	7.89	17.34	5.94	174.92	408.67	39.75	190.96	14	0	50.582
	SS-5	7.87	12.67	6.49	203.85	374.46	35.44	201.22	23	6	71.671
	SS-6	8.33	15.31	0.00	300.10	288.37	3.67	42.48	0	0	17.609
	SS-7	8.12	14.88	0.00	225.10	251.55	4.95	55.53	0	0	16.239
	SS-8	7.55	15.51	1.44	144.90	257.04	2.67	48.82	0	0	15.804
Standard (BIS, 2012)		6.5-8.5	5	5	300	500	45	200	0	0	
Units			mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	MPN/ 100ml	MPN/ 100ml	

winter. Thus, the amount of dissolved minerals in the water of the area is not much of a concern.

The amount of nitrate (NO_3) mostly not exceeding the permissible limits in the area. At SS-1, the level of NO_3 is higher probably due to the contamination of fertilizers from nearby agricultural lands.

Sulphate (SO_4) concentrations in some surface-water samples cross the permissible limits in different seasons. This may be indicative of organic and sewage contamination.

Ideally total coliform (TC) and faecal coliform (FC) should be absent in drinking and domestic purpose-used water. TC was found in 100% and FC in 60% of surface-water samples from the area which is alarming (Sharma and Vyas, 2022). TC was found in one groundwater sample.

WQI is a handy tool for the management of water quality as it gives a single composite value of the water standard of all the parameters. WQI of the samples from all the surface-water sites are 'poor' and some of them reach the 'very poor' status (ranges 50.582-87.969). Whereas the status of groundwater and municipal supply sources is 'good' or even 'excellent' in some cases (ranges 15.804 - 36.210) (Addisie, 2022; Kushwaha *et al.,* 2022).

Conclusion

Contamination of water from anthropogenic activities becomes an immense threat and needs

immediate attention (Mukherjee and Paramanik, 2022). The present study was conducted to understand the degree of water pollution, usability, and its seasonal variation at Gushkara. Analysis showed that the water quality parameters of the studied surface-water (ponds) are near or crossing the permissible limits in many cases. Contaminations from daily use, domestic, municipal, and/or agricultural sources are evident. Parameters of the groundwater (tube well and well) and the municipal supply are rather within safe limits. People use pond water for bathing, washing, and other domestic purposes, sometimes for drinking. WQI recommends immediate attention to the surface-water sources of the area.

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